



Energy Efficiency Potential and Programs for Residential, Commercial, Industrial Facilities

Bill Prindle
Vice President
NCSL Webinar
July 8, 2010

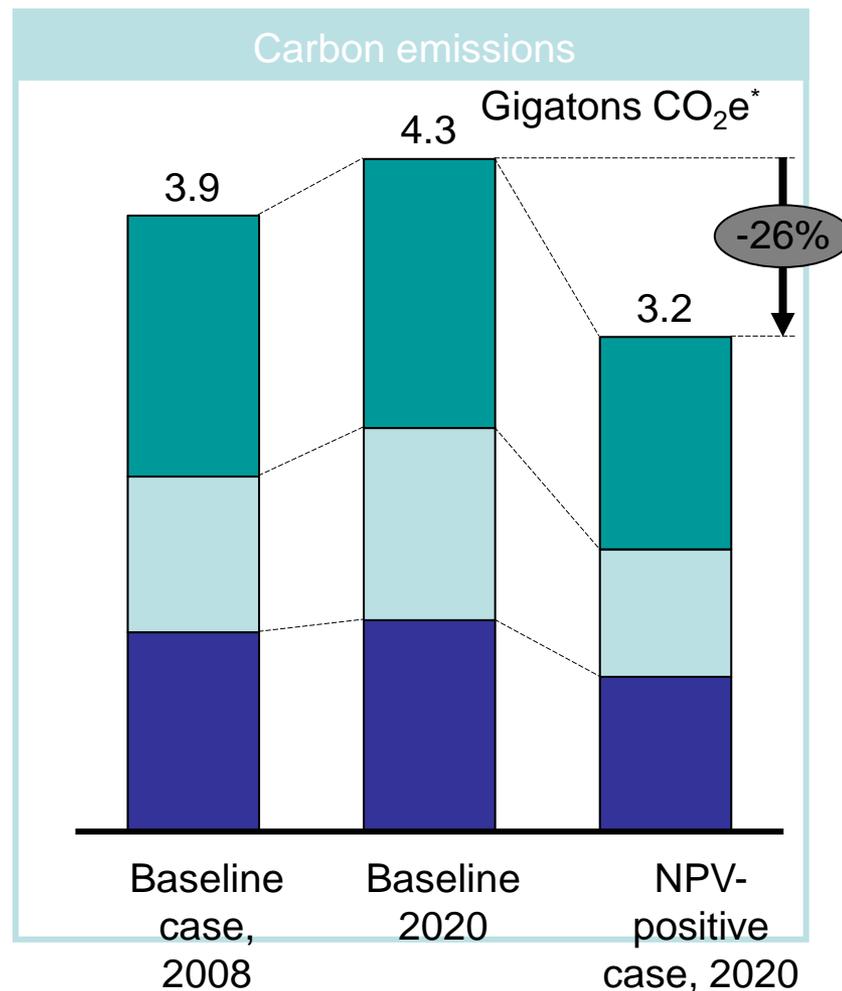
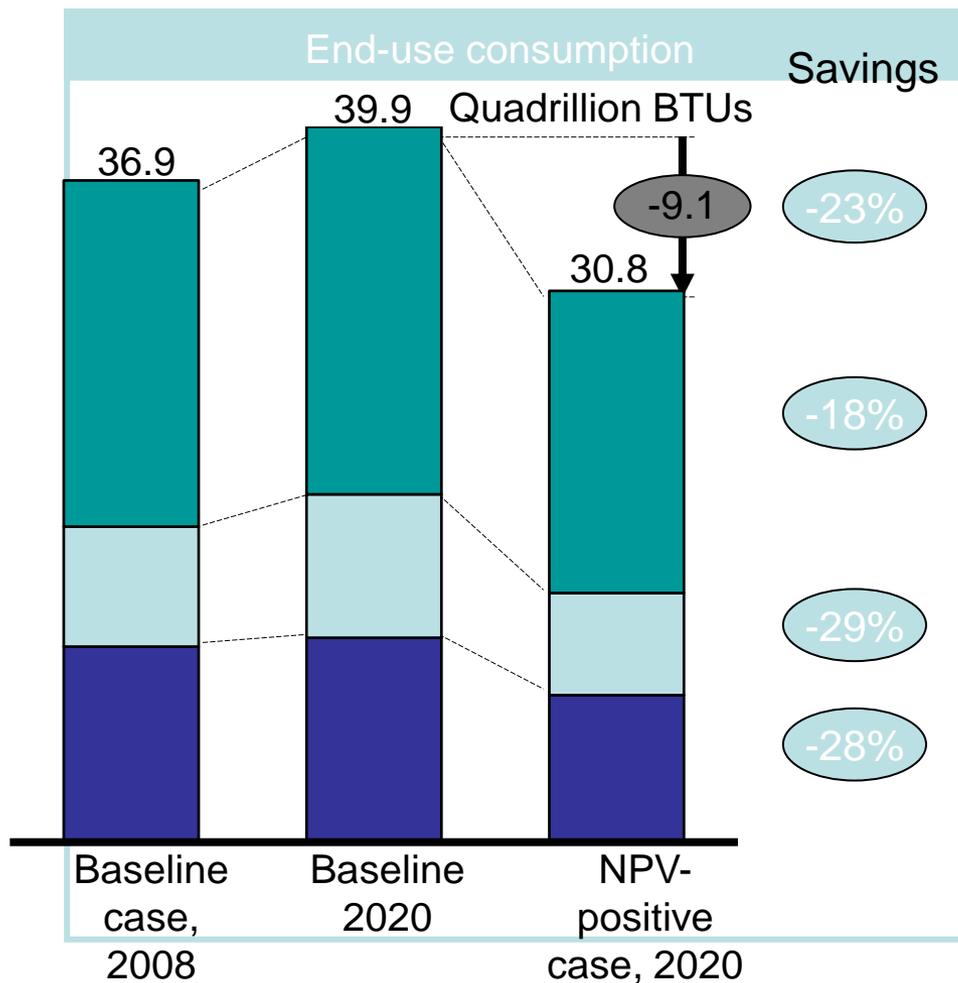
Overview

- Review energy efficiency potential
- Examine specific efficiency opportunities in residential, commercial, industrial facilities
- Identify market barriers that limit efficiency investments
- Define program models that can penetrate barriers
- Outline roles that state legislatures can play in enabling effective programs

Latest U.S. Efficiency Potential Study

- Conducted by McKinsey in 2009, sponsored by EPA and several other organizations
- Builds on and consistent with other studies over the past decade, such as:
 - DOE's *Scenarios for a Clean Energy Future*
 - State potential studies by ACEEE and others
- Provides the most comprehensive national efficiency potential assessment yet conducted

U.S. Efficiency Potential Estimates

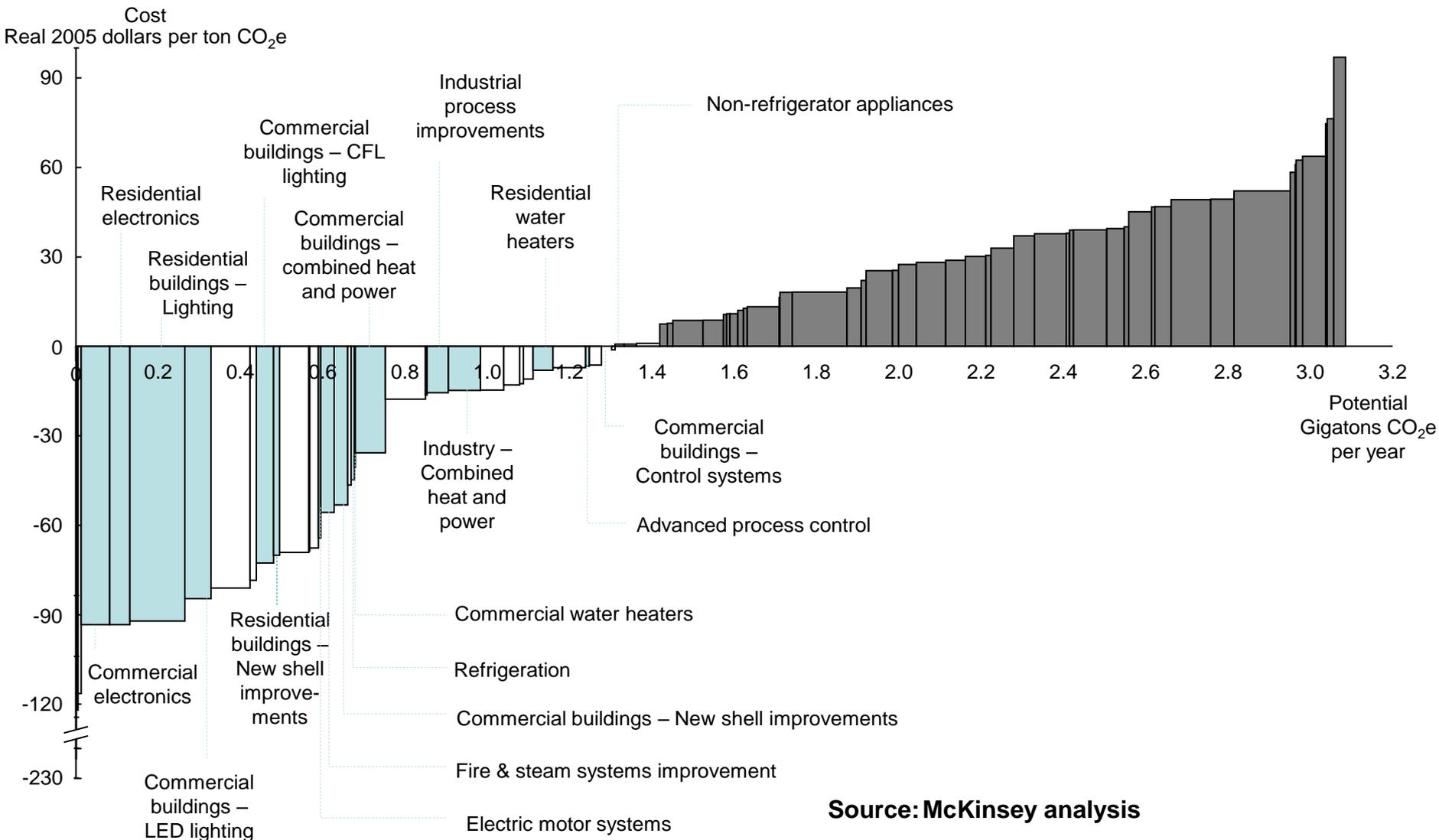


*Includes carbon emission abatement potential from CHP

Source: EIA AEO 2008, McKinsey analysis

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Efficiency: the Cheapest Carbon Savings



Residential Efficiency Measures

- Building envelope:
 - Insulation
 - Windows
 - Air sealing
 - Duct sealing
 - Passive solar design—window area/orientation, shading, thermal mass

Residential Efficiency Measures

- Heating/cooling/hot water systems
 - High efficiency boiler/furnace
 - High efficiency air conditioner
 - High efficiency fan/pump
 - Geothermal heat pump
 - Correct sizing and installation key to performance
 - High-efficiency water heater—tankless, condensing, heat pump
 - Efficient distribution—ducts, pipes
 - ENERGY STAR product specs cover most of these

Residential Efficiency Measures

- Appliances and “plug loads”—fastest growing set of end uses
 - “white goods”—refrigerator, clothes washer, dishwasher
 - Lighting—permanent fixtures, movable fixtures
 - Home entertainment—TV, DVR, DVD, game console, audio
 - Home office—computer, printer, scanner, fax
 - Phone and other battery recharging
 - ENERGY STAR product specs cover most of these

Commercial Efficiency Measures

■ Building envelope

- Insulation (typically less important than residential)
- Windows (heat gain more important than heat loss)
- Air sealing—less feasible than in residential
- Duct sealing
- Passive solar design—geometry, orientation, shading, window area

Commercial Efficiency Measures

- Heating/cooling/hot water systems
 - Much wider range of technologies—including boiler/furnace but also combined heat and power, thermally-activated cooling
 - Sizing of HVAC systems highly dependent on other design features
 - Commissioning, operation and maintenance key to efficiency performance

Commercial Efficiency Measures

■ Lighting

- Key commercial load—up to 50% of total use
- Many efficiency opportunities—T8, T5 fluorescent, LED, HID
- Design choices affect total lighting needs—task lighting, etc.
- Daylighting can contribute significantly, but needs right architecture and controls

Commercial Efficiency Measures

- Other loads
 - Office equipment
 - IT—workstations, peripherals, printers, servers, data centers
 - Increasingly networked systems
 - Network software solutions can “smartly” power down components
 - Data centers offer huge opportunities
 - Efficient servers
 - Efficient HVAC design
 - Server “virtualization” to optimally load equipment
 - ENERGY STAR specs for computers, office equipment, data centers, servers

Industrial Efficiency Measures

- Common energy services
 - Steam/hot water/chilled water
 - Compressed air
 - Motor systems
- Process-specific technologies
 - Heating/melting/heat treating
 - Drying/curing
 - Distillation
 - And many others.....
- ENERGY STAR plants defined for many sectors

Barriers to Efficiency Investment

- Access to capital
 - Efficiency comes in small bites
 - Project sizes don't attract capital market players
- Market fragmentation
 - Over 100 million buildings
 - Many smaller markets serving these buildings
 - Industries with hundreds of thousands of small companies

Barriers to Efficiency Investment

■ Market Barriers

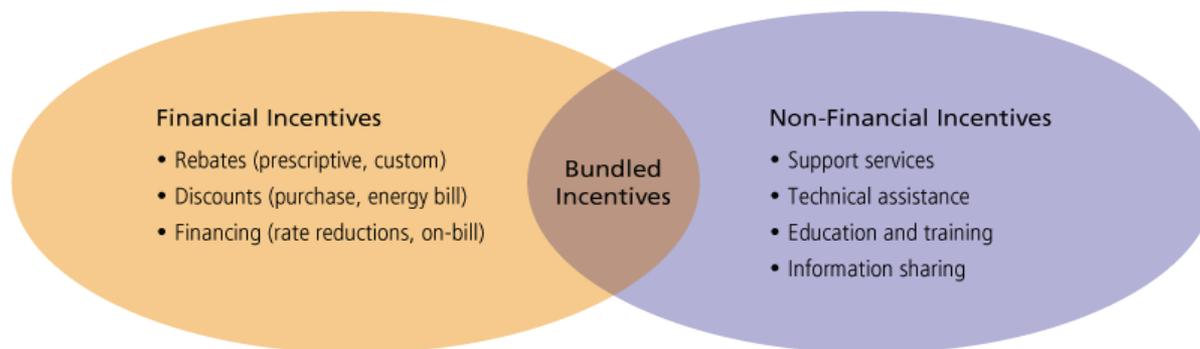
- Principal-agent—homebuilder vs. homebuyer, landlord vs. tenant, facility manager vs. procurement dept.
- Transaction costs—small purchases don't warrant study; information hard to find/analyze

■ Cognitive-behavioral barriers

- Efficiency bundled with other attributes
- Perception of risk/challenge of proving performance
- Cultural-social norms and practices

Utility Programs and Incentives

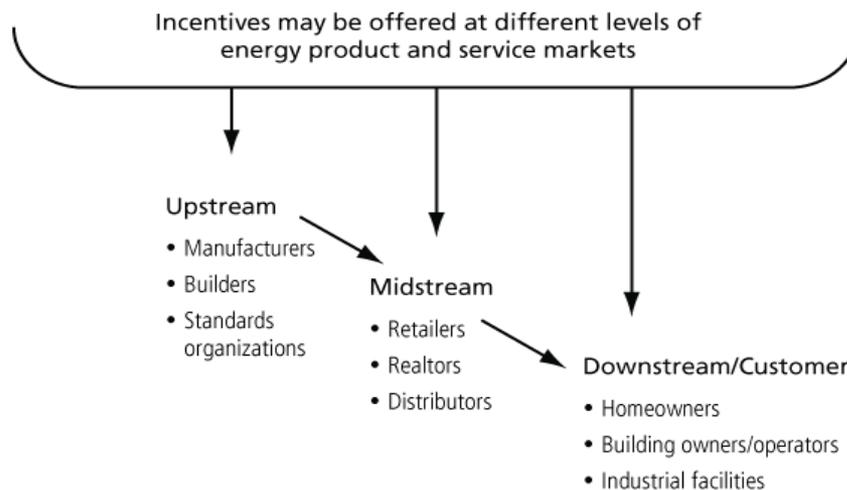
Types of Program Incentives



- Financial Incentives**
- Rebates (prescriptive, custom)
 - Discounts (purchase, energy bill)
 - Financing (rate reductions, on-bill)

Bundled Incentives

- Non-Financial Incentives**
- Support services
 - Technical assistance
 - Education and training
 - Information sharing



Upstream

- Manufacturers
- Builders
- Standards organizations

Midstream

- Retailers
- Realtors
- Distributors

Downstream/Customers

- Homeowners
- Building owners/operators
- Industrial facilities

Source: NAPEE website at <http://www.epa.gov/cleanenergy/energy-programs/suca/resources.html>

How Programs Touch Markets

Incentive Type	Level of Market Intervention		
	Upstream	Midstream	Downstream
Financial <ul style="list-style-type: none"> ▪ Cash rebates ▪ Discounts ▪ Financing ▪ Tax credits 	<i>Example:</i> Cash payment to manufacturers for making products that meet high-efficiency performance criteria	<i>Example:</i> Cash payments to retailers for promoting/ discounting high-efficiency products	<i>Example:</i> Cash rebate to customers who purchase efficient products
Non-Financial <ul style="list-style-type: none"> ▪ Technical services ▪ Information services 	<i>Example:</i> Providing technical assistance to builders and developers to design buildings for high energy performance	<i>Example:</i> Providing point-of-purchase displays and information materials to support retailer promotions of high-efficiency products	<i>Example:</i> Helping customers develop efficiency projects, arrange installation, and ensure quality control
Bundled Incentives and Services <ul style="list-style-type: none"> ▪ Combinations of financial and non-financial incentives 	<i>Example:</i> Offering builders/developers both design incentives and cash rebates for building high-efficiency buildings	<i>Example:</i> Offering retailers cash incentives and providing training for sales staff	<i>Example:</i> Providing design assistance to develop customer projects, arranging financing, and subsidizing interest rates

Source: <http://www.epa.gov/cleanenergy/energy-programs/suca/resources.html>

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Example: C/I Retrofit Program

Customer Segment	Key Stakeholders	Key Program Barriers	Key Program Strategies
Large Commercial and Industrial Retrofit	<ul style="list-style-type: none"> Contractors Building owners and operators Distributors: lighting, HVAC, motors, other Product manufacturers Engineers Energy service companies 	<ul style="list-style-type: none"> Access to capital Competing priorities Lack of information Short-term payback (under two years) mentality 	<ul style="list-style-type: none"> Financial incentives (rebates) Performance contracting Performance benchmarking Partnership with ENERGY STAR® Low-interest financing Information from unbiased sources Technical assistance Operations and maintenance training

Typical measures: motors/drives, compressed air leaks, steam traps, lighting

Example: Home Retrofits Program

Customer Segment	Key Stakeholders	Key Program Barriers	Key Program Strategies
Residential Existing Homes	<ul style="list-style-type: none"> ▪ Distributors: appliances, HVAC, lighting ▪ Retailers: appliance, lighting, windows ▪ Contractors: HVAC, insulation, remodeling ▪ Homeowners 	<ul style="list-style-type: none"> ▪ Higher initial cost ▪ Lack of information ▪ Competing priorities ▪ Inexperience or prior negative experience with technology (e.g., early compact fluorescent lighting) ▪ Emergency replacements 	<ul style="list-style-type: none"> ▪ Financial incentives ▪ Partnership with ENERGY STAR ▪ Information on utility Web sites, bill inserts, and at retailers ▪ Coordination with retailers and contractors

Typical measures: CFLs, air conditioners, water heating, air sealing, duct sealing

Efficiency Program Best Practices: ACEEE Exemplary Programs

Program Profiles	Administrative Organization ¹
Residential Low-Income Programs	
<u>Exemplary Programs</u>	
Multifamily Low-Income Program Indiana Low-Income Weatherization and Refrigerator Replacement Program	Efficiency Vermont Indiana community action programs in partnership with Cinergy/PSI Energy
<u>Honorable Mention</u>	
Assisted Multi-Family Building Program	New York State Energy Research and Development Authority
Residential Air-Conditioning Programs	
<u>Exemplary Programs</u>	
Cool Advantage Keep Cool, New York CheckMe!®	New Jersey Clean Energy Collaborative New York State Energy Research and Development Authority Proctor Engineering Group, Ltd.
Residential Appliances Programs	
<u>Exemplary Programs</u>	
Northeast Residential ENERGY STAR® Appliances Initiative	Northeast Energy Efficiency Partnerships, Inc. and its sponsors and participants
<u>Honorable Mention</u>	
ENERGY STAR® Home Products Program GasNetworks® Residential High Efficiency Heating Program	Northwest Energy Efficiency Alliance GasNetworks

Source: <http://www.aceee.org/utility/bestpractoc.pdf>

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Efficiency Program Best Practices: ACEEE Exemplary Programs

Residential New Construction Programs

Exemplary Programs

Texas ENERGY STAR® Homes Program
Vermont ENERGY STAR® Homes Program
Green Building Program

CenterPoint Energy and Oncor
Efficiency Vermont
Austin Energy

Honorable Mention

Guarantee Program
Wisconsin ENERGY STAR® Homes Program

Tucson Electric Power
Wisconsin Energy Conservation Corporation

Residential Lighting Programs

Exemplary Programs

ENERGY STAR® Residential Lighting Program
Northeast Regional ENERGY STAR® Lighting Program

Northwest Energy Efficiency Alliance
Northeast Energy Efficiency Partnerships, Inc. and its sponsors and participants

Upstream Residential Lighting Program
Upstream Residential Lighting Program

Pacific Gas & Electric
Southern California Edison

Residential Comprehensive and Other Programs

Exemplary Programs

ENERGY STAR® Residential Windows Program

Northwest Energy Efficiency Alliance

Honorable Mention

Shade Tree Program
Manufactured Home Duct Sealing Pilot Program
Cool Roof Program
Wisconsin ENERGY STAR® Suite of Residential Programs

Sacramento Municipal Utility District
Energy Trust of Oregon
Sacramento Municipal Utility District
Wisconsin Energy Conservation Corporation

Home Performance with ENERGY STAR®

New York State Energy Research and Development Authority

Source: <http://www.aceee.org/utility/bestpractoc.pdf>

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Efficiency Program Best Practices: ACEEE Exemplary Programs

Program Profiles	Administrative Organization ¹
Small Commercial Programs	
<u>Exemplary Programs</u>	
Small Business Services Program	National Grid
Downstream Express Efficiency Program	Pacific Gas & Electric
<u>Honorable Mention</u>	
Small Business Energy Advantage	Northeast Utilities: Connecticut Light and Power Company, and Western Massachusetts Electric Company
Commercial/Industrial New Construction Programs	
<u>Exemplary Programs</u>	
Design 2000 plus	National Grid
Energy Conscious Construction	Northeast Utilities: Connecticut Light and Power Company, and Western Massachusetts Electric Company
Energy Design Assistance	Xcel Energy
Commercial/Industrial Custom and Comprehensive Programs	
<u>Exemplary Programs</u>	
Energy Initiative Custom Program	National Grid
Custom Services	Northeast Utilities: Connecticut Light and Power Company, and Western Massachusetts Electric Company

Source: <http://www.aceee.org/utility/bestpractoc.pdf>

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Efficiency Program Best Practices: ACEEE Exemplary Programs

Commercial/Industrial Standard Offer Programs

Exemplary Programs

New York Energy Smart Commercial/Industrial Performance Program
Standard Performance Program

New York State Energy Research and Development Authority
Pacific Gas & Electric, and Southern California Edison

Commercial/Industrial HVAC & Other Programs

Exemplary Programs

Cool Choice

Northeast Energy Efficiency Partnerships, Inc. and its sponsors

Honorable Mention

Rooftop HVAC Maintenance Program
Existing Building Commissioning
ENERGY STAR® Monitor Power Management Program
Compressed Air Management Program

Avista Utilities
Portland General Electric
United States Environmental Protection Agency
Pacific Gas & Electric

Commercial/Industrial Lighting Programs

Honorable Mention

Lighting Efficiency Program

Xcel Energy

Commercial/Industrial Bidding Programs

Honorable Mention

Custom Efficiency
Request for Proposal

Xcel Energy
Connecticut Light and Power

Source: <http://www.aceee.org/utility/bestpractoc.pdf>

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Emerging Program Models

- Information/behavior-based programs
 - Innovated by companies like OPower, Grounded Power
 - Customer usage data mined for key information
 - Benchmarking, goal-setting, feedback are key
 - May be linked to conventional incentive programs
 - Example: Building Performance with ENERGY STAR
 - Example: corporate sustainability programs
- Smart Grid-linked programs
 - May incorporate info-based concepts as above
 - Provide better data, support key M&V goals
 - Linked to demand response, dynamic pricing, appliance control options
 - Drive peak reduction as well as energy savings

State Efficiency Policy Options

- New buildings:
 - Building energy codes
 - Building labeling and rating (mandatory)
 - Voluntary above-code programs
- Existing Buildings
 - Time of sale:
 - Rating/labeling
 - Mandatory upgrades
 - Financing/voluntary upgrades
 - Appliance/equipment standards
 - Elective retrofits: audits, incentives, financing
- Public Buildings
 - Construction standards
 - Existing buildings savings targets
 - Financing mechanisms

State Efficiency Policy Options

- Tax incentives (can affect new or existing buildings)
 - Income tax credits/deductions
 - Sales tax exemptions
- Utility-sector policies (can affect all buildings markets)
 - Energy Efficiency Resource Standards
 - Public Benefits Funds
 - Integrated Resource Planning
 - Ratemaking policies
 - Pricing and rates
 - Revenue decoupling
 - Shareholder earnings
- Utility-sector policies typically include customer program offerings
 - Programs provide various bundles of incentives, technical assistance, and information to help overcome barriers

State Policy Steps to Support Customer Efficiency Programs

- Review/reform utility sector regulation and ratemaking to encourage efficiency investment
- Make efficiency a long-term resource planning commitment
- Draw on peer experience from other states
- Define the most appropriate program delivery model
- Set clear goals and incentives
- Use evaluation for continuous improvement

Contact Information

wprindle@icfi.com

202-862-1179

1725 Eye St. NW, 10th floor

Washington, DC 20006